PRELIMINARY NOTES ON THE VEGETATION OF THABA 'NCHU

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ABSTRACT

The vegetation of Thaba 'Nchu (7,018 feet), a prominent mountain in the 30-inch rainfall area of the south-eastern Orange Free State, is described Special attention is paid to the influence of aspect and elevation on the vegetation. The soil is generally coarse, being derived from sandstone.

The most important perennial plants (105 spp.) are divided into nine communities, namely: Themeda Grassveld, Dry Mesophytic Bush, Xerocline Kloof Forest, Hyparrhenia Grassveld, Passerina-Cliffortia Association, Buddleja-Leucosidea Kloof Forest, Plateau Sourveld, Chasmophytic communities and Mesocline Tall Bush. The edaphic and microclimatic conditions prevailing in each community are discussed.

The relationships between the various communities are considered and special attention is paid to the presence and significance of the communities which represent the southern element of the flora of South Africa.

The role of fire in stabilizing the plateau grassveld is discussed in conjunction with the environmental factors which influence the distribution of the temperate Macchia community.

Based on the writer's observations in other parts of the country, the sociological position of the Buddleja-Leucosidea Kloof Forest, with regard to a Podocarpus forest, is postulated.

INTRODUCTION

The mountain known as Thaba 'Nchu rises 1,768 feet above the plains of the south-eastern Orange Free State grassveld, reaching a height of 7,018 feet above sea-level.

Situated in the 30-inch rainfall region and being in relatively close proximity to the mountains of Basutoland to the east and the plains which are rapidly being encroached upon by the karoo vegetation to the west, Thaba 'Nchu constitutes an unusual admixture of vegetation types whose inter-relationships are of special interest to the student of plant ecology.

GEOLOGY

The mountain falls within the area of South Africa underlain with parent rock of the Beaufort series of the Karoo system, which comprises a large area of the eastern part of the country.

The larger portion of the parent rock found on Thaba 'Nchu is sandstone of the Stormberg series, with the exception of the peaks dominating the summit, which are constituted of the Cave Sandstone so typical of the mountains of the eastern districts of the province.

SOILS

The soils derived from the sandstone parent rock are generally course and relatively infertile in comparison with the darker and richer soils derived from dolerite on hills and dykes in this district. Since soil conditions are the limiting factor in the case of certain edaphic climax communities, special mention is made of the soil conditions within the various communities described below.

CLIMATE

Striking vegetation changes indicate that in the absence of soil variations several meteorological factors are responsible for important differences in the microclimate experienced by situations occurring at various altitudes and on various aspects.

The part played by aspect in determining the floristic composition of the vegetation is especially striking along the upper edge of the eastern ridge, which comprises a steep-sided ridge running in an east-west direction on which vegetation types growing at the same altitude, on soil derived from a common rock, display marked differences in floristic composition, although they occur within 20 yards of each other in some places.

In general, edaphic and botanical features indicate a tendency toward a more moist microclimate with increase in elevation on similar slopes and aspects. At an elevation of over 7,000 feet, it is perhaps to be expected that not only would total rainfall be higher than on the surrounding plains (5,200 feet), but that the intensity and distribution of the precipitation, in conjunction with the more frequently occurring mist and cloud, would result in a considerably greater efficiency of the rainfall in promoting plant growth at such elevations.

Thus, although as mentioned earlier, present edaphic conditions, with moisture as the most important thereof, are closely correlated with the flora supported by various situations and may be regarded as being largely responsible for the various types of vegetation present, the interactions between temperature, evaporation and soil moisture resulting from differences in intensity of radiation, must be regarded as a basic cause of many of these variations in the vegetation.

VEGETATION

For the purposes of this outline of the flora, the vegetation of the mountain has been grouped into the following types:

1. *Themeda Grassveld*, occurring at the base of the mountain.
2. *Dry Mixed Bush*, occurring at low elevations on drier aspects.
3. *Xerocline Kloof Forest*, occurring in watercourses up to an altitude of approximately 6,000 feet.
4. *Hyparrhenia Grassveld*, occurring on the xerocline at higher elevations.
5. *Passerina-Cliffortia Association* in rocky, high altitude habitats, protected from fire.
6. *Buddleja-Leucosidea Kloof Forest* in protected situations at high altitude.
7. *Plateau Sour Grassveld.* A dense, high altitude grassveld community on level terrain.
8. *Chasmophytic Communities.*
9. *Mesocline Tall Bush*, which dominates certain moist aspects at higher elevations.

1. Themeda Grassveld

The plains surrounding the mountain are typical in floristic composition of large areas of the southern and south-eastern Orange Free State. The grassveld is of the mixed veld type with the following species the most abundant: *Themeda triandra, Cymbopogon plurinodis, Eragrostis chloramelas, E. lehmanniana, Elionurus argenteus, Digitaria argyrograpta* and *Heteropogon contortus.*

This *Themeda-Cymbopogonveld*, as Acocks* designates it, occurs on heavy loam or clay soils and frequently displays indications of retrogression, the subclimax stage of the succession frequently being dominated by *Eragrostis lehmanniana, E. superba, Aristida congesta* and *Sporobolus fimbriatus*, with *Aristida diffusa* variety *burkei* a common dominant on shallow hillside soils. The pioneer stage is represented by *Aristida curvata, A. barbicollis, Cynodon dactylon, C. hirsutus, Chloris virgata, Tragus koelerioides* and *Sporobolus ludwigii.*

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*Acocks, J.P. Veld Types of South Africa. Bot. Survey Mem. No. 28

2. DRY MIXED BUSH

This community occurs on the lowest slopes of the mountain, becoming gradually denser with decrease in elevation above the surrounding plains. Dry mixed bush occurs on well-drained soil derived from coarse sandstone and is well developed on the lower northern slopes of the mountain. In general, the trees do not exceed a height of 8 feet, the majority of woody shrubs being below 5 feet in height. The most important trees in this stony grassveld consist of *Rhus erosa*, *R. lancea*, *R. dentata*, *Diospyros austro-africana* variety *microphylla*, *Euclea obovata*, *E. crispa* and *Cussonia spicata*. Important associated shrubs and herbs in the dry mixed bush are *Maytenus cymosus*, *Artemesia afra*, *Asparagus denudatus*, *A. concinnus*, *Solanum incanum*, *S. panduraeforme*, *Walafrida saxatilis*, *Chrysocoma tenuifolia*, *Aster muricatus*, *A. filifolius*, *Gazania krebsiana* and *Lantana rugosa*.

The ground cover includes many representatives of the nearby *Themeda-Cymbopogonveld*, as well as several species of the *Gramineae* which are characteristic of stony hillside habitats or coarse gravelly soils commonly found on the xerocline of hills and stony ridges in the southern districts of the province. Among the characteristic hillside grasses may be listed *Brachiaria serrata*, *Heteropogon contortus*, *Rhynchelytrum setifolium*, *Aristida diffusa* variety *burkei*, *A. canescens*, *Cymbopogon excavatus*, *Enneapogon scoparius* and *Hyparrhenia hirta*. Other common grass species, although not characteristic of hillside situations, include *Themeda triandra*, *Cymbopogon dieterlenii*, *C. plurinodis*, *Eragrostis chloromelas*, *E. lehmanniana*, *E. superba*, *E. curvula*, *Elionurus argenteus*, *Setaria flabellata*, *Sporobolus fimbriatus* and *Digitaria eriantha*.

In localized areas where animals tend to concentrate *Cynodon hirsutus* and *Sporobolus fimbriatus* are common, with *Aristida curvata* and *A. barbicollis* abundant on denuded areas.

This portion of the mountain has clearly been subjected to a heavier grazing intensity than is the case in more elevated areas and, partly as a result of such treatment, a sparse cover and the erosion associated with such a condition on sloping soil is of common occurrence.

3. XEROCLINE KLOOF FOREST

The major watercourses which drain the northern slopes support a characteristic mixed bush which has a closed canopy. The community consists largely of woody trees and shrubs which are typical of the tropical element of the flora of Thaba 'Nchu. As a result of the steep slope of such watercourses, the resultant erosion has resulted in a rocky habitat immediately adjacent to the drainage area of the ravines.

The most abundant trees occurring in the xerocline kloof forest are *Rhus lancea, Olea verrucosa, Euclea crispa, Cussonia paniculata, Grewia occidentalis, Rhus pyroides* variety *typica*, with *Heteromorpha trifoliata, Clutia pulchella, Osyris compressa, Xylotheca kraussiana* variety *glabriflora* and *Rhamnus prinoides* becoming more important at higher altitudes, i.e. above 6,000 feet.

As a result of the dense shade cast by the kloof forest a poorly developed ground cover occurs, while the climber *Rhoicissus cuneifolius* is commonly found in a variety of trees.

4. HYPARRHENIA GRASSVELD

The drier habitats of the northern slopes situated at an elevation of above 6,000 feet are characterized by the dominance of *Hyparrhenia hirta*, with trees and large shrubs limited almost entirely to the upper reaches of the watercourses and to the immediate vicinity of large sandstone boulders. It would appear that the protection from fire, afforded by such rocky habitats, is responsible for large trees and woody shrubs being limited almost entirely to such situations on this portion of the mountain.

The conditions favouring the occurrence of fierce grass fires are much more prevalent in the higher-lying *Hyparrhenia* veld for several reasons. Firstly, the tall growth form of the *Hyparrhenia* is conducive to a more damaging fire than would be expected from the shorter growing grassveld at lower elevations. Secondly, the more remote and steeper high-lying slopes, on which *Hyparrhenia* is dominant, are less prone to intensive grazing pressure than is the case on the lower slopes which are more easily accessible to grazing animals and consequently show marked indications of over-grazing.

Associated with *Hyparrhenia* in this grassveld community are several grasses which are characteristic of mountain slopes in this part of the province, namely: *Brachiaria serrata, Rhynchelytrum setifolium, Aristida diffusa* variety *burkei, A. canescens, Setaria flabellata, Cymbopogon dieterlenii*, with *Hyparrhenia glauca* and *Pennisetum sphacelatum* locally dominant in moist habitats receiving full sunlight.

5. PASSERINA-CLIFFORTIA ASSOCIATION

Adjacent to the summit plateau lie large slabs of rain-washed and weathered sandstone between which pockets of soil have accumulated. The shallow soils in these pockets support an interesting temperate flora, dominated by shrubs which are collectively termed Macchia or "Fynbos". These representatives of the temperate flora of the western Cape form a community which is strikingly different from the other types of vegetation found in this part of the country. Their relationship to the local karroid element of the vegetation is of particular interest, especially when typical karoo pioneers such as *Chrysocoma tenuifolia* are found growing in this community to a height of 3 feet and having a canopy diameter of 3—4 feet. This relationship is discussed later, in conjunction with large-scale migrations of vegetation.

The most abundant sclerophyllous species are *Passerina montana, Erica maesta, Cliffortia nitidula, Stoebe vulgaris* and *Anthospermum tricostatum.* These evergreen dark green or silver shrubs are only found above an altitude of about 6,500 feet, *Stoebe vulgaris* being found at somewhat lower elevations than the others in this community. In certain high altitude situations on steep northern slopes these sclerophyllous species grow in a mixed community with certain grasses commonly found in high altitude mountainous areas, namely *Koelaria cristata, Eragrostis racemosa* (= *E. chalcantha*), *E. capensis* (= *E. brizoides*) and *Pentaschistis setifolium.*

The genus *Pentaschistis* is especially noteworthy in this part of the country, since, like *Ehrharta,* it is a temperate genus, abundant in the south-western Cape and only found in the south-eastern portion of South Africa along migration routes, such as the Stormberg and Drakensberg mountain ranges where sufficient winter moisture and relatively cool summer temperatures result in environmental conditions suitable for its existence.

6. BUDDLEJA-LEUCOSIDEA KLOOF FOREST

The *Buddleja-Leucosidea* kloof forest consists of a closed forest 8—15 feet high occurring in sheltered ravines at altitudes above 6,500 feet, in which sufficient soil is available to support a dense forest growth.

Although *Buddleja salvifolia* and *Leucosidea sericea* may be regarded as the trees which are most typical of this community, several other tall-growing woody species are associated with these species. Such forest species include *Printzia pyrifolia, Clutia pulchella, Euclea crispa, Osyris compressa, Xylotheca kraussiana* var. *glabrifolia, Heteromorpha arborescens, H. trifoliata, Myrsine africana* and *Rhamnus prinoides.*

The lianes *Rhoicissus cuneifolius* and *Cissus anatomicus* are also common in this forest community, which, due to the dense shade cast by the canopies of the trees, includes but a poorly developed ground layer in many parts.

Buddleja salvifolia and *Leucosidea sericea* also occur in localized moist sites on the xerocline at altitudes above 6,000 feet where reduction in slope results in accumulation of runoff water from the rocky slopes.

When it is borne in mind that *Buddleja salvifolia* and *Leucosidea sericea* are commonly regarded as forest-margin species to *Podocarpus* climax forest in several parts of South Africa, their appearance on Thaba 'Nchu, especially associated as they are with *Rubus ludwigii*, *Leonotus leonurus* and *Helichrysum nudifolium*, is of special significance in postulating the climatic climax of the situations concerned. This aspect is considered later in the discussion of relationships between the vegetation types occurring on the mountain.

7. PLATEAU SOUR GRASSVELD

Between the rocky outcrops and peaks of Cave Sandstone which form buttresses around the edge of the summit, lies a plateau of level or gently undulating ground with a relatively deep fertile soil which is dark in colour and has a high organic matter content as compared with the soils of other situations on the mountain.

The plateau is virtually devoid of trees and woody shrubs, the open rolling grassveld affording good summer grazing.

The dominant grasses are typical of the sour veld communities of the high-lying mountainous areas of the eastern districts of South Africa, many of the most important species being confined almost entirely to such areas.

Mixed dominance occurs generally over most of the plateau area, the most abundant species being *Andropogon appendiculatus*, *Helictotrichon turgidulum*, *Microchloa caffra*, *Pennisetum sphacelatum*, *Fingerhuthia sesleriaeformis*, *Eragrostis capensis* (= *E. brizoides*), *E. racemosa* (= *E. chalcantha*), *E. caesia*, *E. plana*, *E. planiculmis*, *E. chloramelas*, *Harpechloa falx*, *Cymbopogon dieterlenii*, *Koelaria cristata*, *Digitaria monodactyla*, *Themeda triandra*, *Elionurus argenteus* and *Sporobolus fimbriatus*.

In moist shady habitats, several moisture-loving grasses are abundant, namely, *Bromus speciosus*, *B. catharticus*, *Stipa dregeana* var. *elongata*, *Festuca longipes* and *Agrostis bergiana*.

The physiognomy and floristic composition of the plateau sour veld indicate that regular burning is an important environmental factor responsible for the dense short grassveld sward prevailing. The absence of rocks and the protection which they afford from fire, probably accounts for the almost complete lack of woody plants representing stages in the succession above the grassveld stage.

The level terrain, together with the more moist high altitude microclimate and the lower temperatures associated with such conditions, would undoubtedly result in lower runoff, a more moist soil and lower evaporation as a result of the lower temperatures in this region. In the absence of regular fire, a rapid progressive succession may well result first in a tall *Hyparrhenia glauca-veld*, followed by the forest margin shrubs *Leucasidea sericea* and *Buddleja salvifolia*, or alternatively in a dense growth of macchia of mixed dominance, with *Passerina montana*, *Erica maesta*, *Cliffortia nitidula* and *Anthospermum tricostatum* dominating the lower-growing members of this community such as *Stoebe vulgaris* and *Helichrysum dregeanum.* The writer has observed that overgrazed *Themeda-Tristachya* grassveld on the Amatola mountains reverts to a sere dominated by *Helichrysum*, which, when protected from fire and grazing for many years, progressed via the grassveld sere to a sere dominated by *Cliffortia* and other macchia types. Similarly, cessation of burning has resulted in the development of thickets of *Elytropappus rhinocerotis* in coastal areas near Grahamstown.

8. CHASMOPHYTIC COMMUNITIES

The temperate macchia type of vegetation mentioned earlier is supported mainly by the pockets of soil between the large slabs of sandstone at high altitudes. In situations which present less favourable edaphic conditions in these rocky situations, several chasmophytic genera are found to represent a local edaphic climax, namely, *Ruschia putterilii*, *Eriocephalus eximius* and *Pentzia tortuosa.* This low bush community appears to be a reaction not only to poor edaphic conditions but also to continuous wind exposure, especially on the bare convex formations on the highest rocky peaks.

These bushes usually occur in isolated colonies and display an open structure owing to the absence of soil. As soil accumulates, so a more varied and complex community is built up from representatives of the surrounding bush communities. The grasses most commonly included in this chasmophytic community are *Eragrostis caesia* and *E. planiculmis.*

9. MESOCLINE TALL BUSH

On the more elevated sites of the mesocline of the eastern ridge a bush community, varying in density from relatively open to an impenetrable thicket in the more sheltered habitats, occurs. The greater portion of the mesocline is south-west facing, and as a result of aspect and slope receives the sun's rays at such an oblique angle that during winter, even in the areas which support open bush, the soil receives virtually no direct sunlight. The cooler and more moist conditions prevailing on such situations are responsible for a formation and floristic composition which is completely different from the xerocline community at the same altitude. The direction of rainfall may also be a factor responsible for this contrast. In general, these mesocline slopes are not as stony as the xerocline closeby, while the evenly distributed nature of the bush gives the impression of at least a certain degree of protection from fire, as opposed to the xerocline bush which is restricted to damp ravines or the immediate vicinity of large boulders. The mesocline bush is of mixed dominance with *Rhus dentata, R. divaricata, Euclea crispa, Rhus dregeana, Leucosidea sericea* and *Rhamnus prinoides* the most abundant shrubs. In the second layer of the vegetation of the mesocline tall bush, the following species are common: *Selago galpinii, Sutera pristisepala, Helichrysum nudifolium, Pentzia cooperi, Leonotus leonurus, Lotononis trisegmentata, Lasiosiphon capitatus, Senecio isatideus, Indigofera zeyheri, I. stenophylla, I. hedyantha, Hebenstretia cooperi, Eriocephalus eximius, Aster petiolatus, Sutherlandia frutescens* and *Osteospermum scariosum.*

RELATIONSHIPS OF THE VEGETATION

The sociological status of the various communities representing the tropical element of the flora of Thaba 'Nchu in relation to each other is relatively simply explained, moisture conditions in localized situations being the most important factor determining the degree to which progressive succession will develop in each habitat.

While the important effects of edaphic conditions and protection from fire on the structure of the temperate macchia are often striking, the relationship between this temperate element of the mountain's flora and the tropically derived element is somewhat obscure. This is particularly so when the environmental conditions suitable for the tropical savannah flora, the karroid vegetation and the temperate sclerophyllous bush respectively are considered. As mentioned earlier, the writer has observed that cessation of veld burning in several parts of the country leads to a more luxuriant growth of the macchia community and often a spreading thereof. Generally, the migration of this form of temperate flora has taken place along mountain ranges which offer climatic conditions more suitable for its spread than is afforded by vast plains.

The increase of such sclerophyllous species as *Stoebe vulgaris* in the northern Orange Free State and of *Athanasia acerosa* in the vicinity of Curry's Post in Natal are considered as being part of the macchia movement in South Africa, but whether the macchia occurring on Thaba 'Nchu is the relic of an earlier more northernly temperate flora than is the case to-day, or whether it constitutes a more modern northward and eastward migration of the "Cape Flora" is difficult to establish.

There is a gradual yet complete transition between the more xerophytic bush communities of the drier slopes and the sclerophyllous communities at higher altitudes; however, interesting examples of mixed hillside grassveld consisting of species typical of low hills in the central portion of the province are found as high as 6,500 feet above sea-level on Thaba 'Nchu. At such high elevations the close affinity between the tall sclerophyllous bush or macchia and the karroid vegetation is clearly displayed. Where such species as *Walafrida saxatilis, Aster filifolius, A. muricatus, Chrysocoma tenuifolia, Pentzia cooperi* and *Helichrysum dregeanum* are found growing side by side with the tall genera such as *Passerina, Cliffortia, Erica* and *Anthospermum*, it is not difficult for the student of plant ecology to accept that the karroid vegetation is an adaptation of the temperate macchia to the arid conditions of the karoo areas.

When the denser and often taller growth of grass and herbs on steeper higher-lying slopes is compared with the basal cover and height of the grass sward found on the lower more gentle slopes, the significance of overgrazing and selective grazing as causal agencies of these differences should not be underestimated in favour of microclimatic considerations. The general effect of regular grazing is to produce a less dense vegetation with a structure which indicates more xerophytic conditions than actually exist. In addition, the moister soil resulting from the proportionately larger surface area covered by rock, causing important runoff differences at high elevations, is of great importance in comparing the grassveld communities of the upper and lower slopes.

On first confronting the *Buddleja-Leucosidea* Kloof Forest, the designation of the sociological status of this community in relation to a possible *Podocarpus* climax forest immediately presents an issue worthy of further consideration. The writer has observed these two tree species acting as forest-margin plants seral to a climax *Podocarpus* forest on the Hogsback mountains of the eastern Cape, on Rensburgskop in the eastern Orange Free State, in several localities of the Drakensberg in the Estcourt district and in the Weza forest near Kokstad. The absence of *Podocarpus* species from the sheltered ravines on the high elevation mesocline of Thaba 'Nchu is difficult to explain in terms of edaphic limitations, when the abundance of *Buddleja* and *Leucosidea* together with the edaphic conditions prevailing in the marginal zones of *Podocarpus* forests in other parts of the country are considered. In the light of Clement's theory based on the monoclimax concept, continued reaction of the present dominants would be expected to lead eventually to the appearance of *Podocarpus* in this kloof vegetation. An explanation would thus have to be sought for the absence of *Podocarpus* from this seemingly permanent and stable *Buddleja* and *Leucosidea* forest supported by a soil which is apparently suitable for the *Podocarpus* climax. Alternatively the present community may be considered as the ultimate stage in progressive succession, as originally explained by Tansley as follows: "If the change is too slow to appreciate or too small to affect the general nature of the vegetation, the apparently stable phase must still be called a climax".

Three factors may be limiting either individually or collectively in the occurrence of *Podocarpus* on Thaba 'Nchu, namely, too long an annual period of frosty weather, too low a rainfall and the absence of the symbiotic bacteria associated with root nodule formation in *Podocarpus falcatus* and *P. latifolius.* It is further possible that the frequency of fires in such situations has been higher than is necessary for the succession to pass through all the seral stages preceding the *Podocarpus* climax.